Determinants of death among under-5 children in Bangladesh

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Abstract

Background
It is well established that improving human health has direct obvious payoff on enhancing life expectancy along with economic growth. Under-5 child mortality deliberately used to understand a countries overall public health status. In Bangladesh, child mortality remains a significant public health problem. Therefore, the chief intention of this undertaken study was to ascertain the best possible important factors of pre-school child mortality in Bangladesh.

Methods
This study was based on large dataset of Bangladesh Demographic and Health Survey, 2014 (BDHS-2014). Based on an extensive literature review thirteen covariates were selected. Chi-square test was accomplished to find out the association with under-5 deaths. The factors which achieved statistical significance (p<0.05) were put into binary logistic model for multilevel adjustment.

Results
Obtained results described different geospatial, socioeconomic, demographic and health factors i.e. division, parents' education, fathers' occupation, wealth index of family, type of toilet, birth status (single or multiple birth), vitamin A and antenatal care visit during pregnancy were significantly associated with under-5 child mortality. Results of the binary logistic regression revealed that lower level of father's education, multiple birth and not receiving vitamin A dose were found the strong predictors of influencing early childhood mortality.

Conclusion
A nationally representative data had been used to reflect the recent mortality pattern in this country. Different socio-economic, health and demographic factors are associated with U5CM. This evidence based empirical study suggests that more attention needs regarding to stall all kinds of child mortality in Bangladesh.

Keywords: Determinants, Child, Mortality, Under-5, Infant, Bangladesh

Background

In developing countries like Bangladesh studying about under-five child mortality got an attention to researchers due to the prevalence of high rate of under-5 child mortality (U5CM) across the globe [Mohammad & Bari, 2017]. Child mortality is an acceptable and important health indicator of a country [McGuire, 2006]. The number of U5CM per 1000 live births is defined as the rate of child mortality which is also a vital indicator of the overall national development [McGuire, 2006]. There have enormous positive achievements in reducing child mortality across the world over the last few decades [Ahmad et al., 2000, Black et al., 2003, Liu et al., 2010]. For instance, the number of U5CM had shown gradually decreased from 10.5 million in 1999 [Ahmad et al., 2000] to 7.6 million in 2010 [Liu et al., 2010]. Despite these gains, the child mortality rate is still high in sub-Saharan Africa and South Asia [Liu et al., 2010].

In the last two decades, Bangladesh has achieved enormous positive outcome relating to under-5 child survival. For example, the U5CM rate in Bangladesh was 133 per 1000 live birth in 1993 [Bangladesh Demographic and Health Survey, 1993-94], while in 2014 it decreased to 38 per 1000 live birth [NIPORT Mitra & Associates, 2016]. Although, Bangladesh has already acquired the Millennium Development Goal-4 with 65% decline rate between 1993 to 2014, until now a large portion of children in Bangladesh every year has been demised due to lack of appropriate conscious and initiatives [NIPORT Mitra & Associates, 2016]. Consequently, appropriate actions are still required to ameliorate the situation so that the survival rates of the children get increased. The achieve SDGs goal-3 which put emphasized onto ending all kinds of child mortality by 2030.

Child mortality has been influenced by many factors and among so many factors poverty is being considered the momentous reason of child mortality in Bangladesh or in the globe [Black et al., 2003, Adedini et al., 2015]. Further, wealth index has found as a significant factor of U5CM in several studies [Mohammad & Bari, 2017, Adedini et al., 2015, Hossain et al., 2011, Karmaker et al., 2014]. Parent's education have been highly significant to influence infant and child mortality [Hossain et al., 2011, Karmaker et al., 2014, Chowdhury et al, 2010, Ezeh et al., 2015, Maniruzzaman et al., 2018, Khan & Awan, 2017, Rahman & Sarkar, 2009, Akter et al., 2015, Breierova & Duflo, 2004, Mazumder et al., 1997, Uddin & Hossain, 2008]. It has also been found

that rural children are more vulnerable to be died than urban children [Hossain et al., 2015, Karmaker et al., 2014, Rahman & Sarkar, 2009, Mondal et al., 2009].Besides, diarrhea [Black et al., 2003, Liu et al., 2010], pneumonia [Black et al., 2003, Liu et al., 2010], vitamin A [Rahmathullah et al., 2003, Klemm et al., 2008, Imdad et al., 2011, Humphrey et al., 1996], occupation of father [Mondal et al., 2009], material's age at first birth [Khan & Awan, 2017], type of toilet facility [Chowdhury et al., 2010, Khan & Awan, 2017, Mondal et al., 2009], male child [Maniruzzaman et al., 2018, Khan & Awan, 2017,Mondal et al., 2009], birth order of children [Maniruzzaman et al., 2018, Hossain et al., 2015] and multiple birth [Alam et al., 2007, Hong, 2006, Kembo & Van Ginneken, 2009, Bereka, 2017] have also been significant predictors of child mortality in previous research. Several studies have acknowledged about the determinants of child mortality in Bangladesh and put forth that continuous assessment and special attention is required in this issue. Thus the current study was intended to determine the potential risk factors affecting under-5 child mortality in Bangladesh.

Methods

Data sources: This study was based on the data of Bangladesh Demographic and Health Survey 2014 (BDHS 2014), which is a periodical cross-sectional study across the country. BDHS data is freely available in online where every identifier information was removed. Observing the U5 mortality status was one of the particular aims of the survey. The methodology of data collection has been reported elsewhere [NIPORT Mitra & Associates, 2016]. A total of 7,886 children's data were used to analyze the findings.

Variables declaration

Outcome variables: The outcomes variables for this study was the death in childhood (0-59 months), measured as the duration of survival since birth in months. The analysis was child-based and fixed to the live births till 5 years. Thus, all children born within the 5 years before the survey were included in the analysis. The children's survival status and the age at death in months (if the child had died) or the last month they were known to be alive (if the child was still living at the time of the survey) were combined to generate the outcome variables for the survival analysis.

Predictor variables: Based on an extensive literature review about infant mortality the predictor variables considered in this paper were: division of residence, gender of child, type of place of residence (rural, urban), mother's and father's education, father's and mother's occupation, wealth index, birth status, type of toilet, birth order, antenatal care visit during pregnancy and vitamin A in 2 months after birth.

Statistical analysis*:* Bivariate and multivariate analyses were accomplished to divulge the significant factors for neonatal mortality. The proportion of the prevalence according to the selected covariates was compared using χ^2 test. The individual association test also performed using χ^2 test. Then with the significant factors (at $p<0.05$) from bivariate level, multivariate binary logistic model was fitted to assess the all possible risk factors for U5 mortality. The results in adjusted cases were interpreted from the odds ratios. Because, Odds ratios from the best fitting model show a relationship between the socio-economic, demographic and geo-graphic categorical variables [Ayele et al., 2015]. The Statistical Package for Social Science (SPSS 23.00) was employed to analyze the data.

Ethical consideration: This study was based on an analysis of DHS data with all identifiers information removed. The survey was approved by the Ethics Committee in Bangladesh and the Ethics Committee of the Demographic and Health Surveys (DHS) Programs.

Results

According to BDHS 2014 data, 96.0% respondents answered that their children were still alive after birth. But it is very melancholic that about 4.0% respondents indicated that their children dead within 0 to 59 months. Table 1 elucidates the characteristics of the children and the prevalence of mortality. A number of 7886 aged below five years old children were considered as the total sample for this study. Approximately 68.5% samples were from rural communities. Nearly sixteen percent mothers and one-fourth fathers never been to formal education. About twelve percent mothers and twenty-five percent father worked in agricultural sectors. Besides, more than 41% of the respondents were from poor families. Moreover, most of the families (77.6%) used pit latrine. Also it is found that 39.2% children were first born and 45.4% and most of the children (98.5%) had single birth. More than half of children did not feed vitamin A supplementary within their two months of age and around one-fifth mothers did not visit antenatal care during their pregnancy.

Except place of residence, sex of the child, birth order and mother's occupation, all other covariates were significantly associated with NMR at the bivariate level (**Table 1**). U5 mortality rate was lowest in Barisal division (2.6%) where it was highest in Sylhet division (5.7%). Mothers with no education caused the higher child mortality to 5.2% while mothers with higher education the child mortality rate were declining trends (1.8%). Similar results also found for father's education. In addition, the rate of U5CM was almost three percent higher among unemployed fathers compared to the fathers who were employed in non-agriculture sectors. Furthermore, the prevalence of U5CM in poor family was significantly higher (5.0%) compared to rich family (3.2%). Moreover, results reveal that the U5MR was almost double among the children who did not feed vitamin A supplementary within two months of age with respect to the children who received it (3.9% vs. 1.4%. Besides, the rate of U5CM was lowest in households with flush toilet. Also, the prevalence of U5 child mortality was significantly lower in the mothers who visited antenatal care (ANC) during their pregnancy compared with the mothers who did not receive services from ANC (2.4% vs. 4.1%; p=0.003). The mortality rate among multiple birth child was remarkably much higher (26.3%) than the single birth child (3.7%).

Table 1: Characteristics of the children and the prevalence of Under-5 mortality[1]

Characteristics and categories	All children	Under-5 death status		χ^2	p-value[2]
		Dead	Alive		
Division				17.55	0.007**
Chittagong	1517 (19.2)	64 (4.2)	1453 (95.8)		
Dhaka	1378 (17.5)	43 (3.1)	1335 (96.9)		
Khulna	862 (10.9)	40 (4.6)	822 (95.4)		
Rajshahi	959 (12.2)	36 (3.8)	923 (96.2)		
Rangpur	958 (12.1)	38 (4.0)	920 (96.0)		
Sylhet	1306 (16.6)	74 (5.7)	1232 (94.3)		
Barisal	906 (11.5)	24 (2.6)	882 (97.4)		
Place of residence				2.05	0.152
Urban	2488 (31.5)	89 (3.6)	2399(96.4)		
Rural	5398 (68.5)	230(4.3)	5168(95.7)		
Sex of children				0.29	0.58
Male	4061 (51.5)	169(4.2)	3892(95.8)		
Female	3825 (48.5)	150(3.9)	3675(96.1)		
Mother's education				16.06	0.001**
No education	1233 (15.6)	64(5.2)	1169(94.8)		
Primary	2206 (28.0)	99(4.5)	2107(95.5)		
Secondary	3621 (45.9)	141(3.9)	3480(96.1)		
Higher	826 (10.5)	15(1.8)	811(98.2)		
Father's education				21.55	0.001**
No education	2008 (25.5)	104(5.3)	1902(94.7)		

Primary	2377 (30.1)	101(4.2)	2276(95.8)		
Secondary	2360 (29.9)	90 (3.8)	2270(96.2)		
Higher	1141 (14.5)	22 (1.9)	1117(98.1)		
Mother's occupation				2.90	0.234
Not Working	5905 (74.9)	224 (3.8)	5681 (96.2)		
Agriculture sectors	951 (12.1)	48 (5.0)	903 (95.0)		
Non-agriculture sectors	1026 (13.0)	42 (4.1)	984 (95.9)		
Father's occupation				8.79	0.012*
Unemployed	224 (2.8)	15(6.7)	209(93.3)		
Agricultural sectors	1938 (24.6)	93 (4.8)	1860(95.2)		
Non-agricultural sectors	5724 (72.6)	211 (3.7)	5513 (96.3)		
Wealth index				13.49	0.001**
Poor	3240 (41.1)	162(5.0)	3078(95.0)		
Middle	1516 (19.2)	56(3.7)	1460(96.3)		
Rich	3130 (39.7)	101(3.2)	3029(96.9)		
Type of toilet facilities				14.58	0.001**
No facilities/ Hanging toilet	461 (5.8)	34 (7.4)	427 (92.6)		
Pit toilet	6123 (77.6)	240 (3.9)	5883(96.1)		
Flush toilet	1303 (16.5)	45 (3.5)	1257(96.5)		
Birth order				5.97	0.056
1^{st}	3094 (39.2)	134(4.3)	2960(95.7)		
2^{nd}– 3^{rd}	3578 (45.4)	125(3.5)	3453(96.5)		
≥ 4rth	1214 (15.4)	60(4.9)	1154(95.1)		
Birth status				152.45	0.000**
Multiple birth	118 (1.5)	31 (26.3)	87 (73.7)		
Single birth	7768 (98 .5)	288 (3.7)	7480 (96.3)		
Vitamin A in first 2 months				26.98	0.000**
No	2410 (53.7)	95 (3.9)	2315 (96.1)		
Yes	2080 (46.7)	29 (1.4)	2051 (98.6)		
ANC visit during pregnancy				8.58	0.003**
No	970 (21.6)	40 (4.1)	930 (95.9)		
Yes	3524 (78.4)	84 (2.4)	3440 (78.7)		

[1]Data is presented as number (percentages)

[2]*p*-value is obtained using Chi-square test.

ANC; Antenatal Care, ***p*<0.01; **p*<0.05.

Table 2 presents the results of the multivariate binary logistic regression. Multivariate As shown, the U5CM was significantly 2.55 times higher in Sylhet division compared to Barisal division. Results also reveal that among the fathers with no education and primary level education were 3.55 times and 2.92 times respectively higher than the fathers having higher education. Additionally, the odds of U5 mortality was higher among children who did not take vitamin A dose compared to their counterparts [OR=2.40; CI= 1.56-3.71]. Besides, the multiple birth children was around twelve-fold more likely to die before completing their 5 years of age compared to the single birth child.

Table 2: Multivariate binary logistic regression analysis for under-5 mortality

Characteristics and categories	Coefficient of β	U5 mortality OR [CI]	*p*-value
Division of residence			
Chittagong	0.452	1.57 [0.64-3.81]	0.318
Dhaka	0.642	1.89 [0.78-4.62]	0.157
Khulna	0.912	2.49 [0.99-6.22]	0.051
Rajshahi	0.705	2.02 [0.81-5.01]	0.127
Rangpur	0.184	1.20 [0.43-3.32]	0.722
Sylhet	0.939	2.55 [1.09-5.99]	0.031*
Barisal (ref.)		1.00	
Mother's education			
No education	0.098	1.10 [0.37-3.25]	0.858
Primary	0.084	1.08 [0.39-2.96]	0.870
Secondary	0.115	1.12 [0.45-2.82]	0.808
Higher (ref.)		1.00	
Father's education			
No education	1.267	3.55 [1.28-9.84]	0.015*
Primary	1.071	2.92 [1.10-7.73]	0.031*
Secondary	0.691	1.99 [0.77-5.13]	0.152
Higher (ref.)		1.00	
Father's occupation			
Unemployed	0.156	1.16 [0.42-3.29]	0.767
Agricultural sectors	0.372	1.25 [0.82-1.91]	0.281
Non-agricultural sectors (ref.)		1.00	
Wealth index			
Poor	-0.088	0.92 [0.52-2.36]	0.759
Middle	-0.155	1.40 [0.46-1.56]	0.616
Rich (ref.)		1.00	
Type of toilet facilities			
No facilities/ Hanging toilet	0.191	1.21 [0.52-2.77]	0.653
Pit toilet	-0.446	0.65 [0.39-1.14]	0.640
Flush toilet (ref.)		1.00	
Birth status			
Multiple birth	2.51	12.40 [5.05-30.41]	0.000**
Single birth (ref.)		1.00	
Vitamin A in first 2 months			
No	0.879	2.40 [1.56-3.71]	0.000**
Yes (ref.)		1.00	
ANC visit during pregnancy			
No	0.191	1.21 [0.80-1.88]	0.395
Yes (ref.)		1.00	

Reference Category: Alive children.

ref.: reference; ANC: antenatal care; **$p<0.01$; *$p<0.05$.

Discussion

This study attempted to analyze the (BDHS-2014) data to estimate the changes in risk factors of U5 child mortality in relation to ongoing interventions by the government of Bangladesh. In this study, division, both mothers' and fathers' educational level, fathers' occupation, wealth index of family, type of toilet, birth status (single or multiple birth), vitamin A in two months and ANC visit during pregnancy were significantly associated with U5CM. Results of the binary logistic regression revealed that Khulna and Sylhet division, lower level of fathers' education, not receiving vitamin A capsule, and multiple birth appeared at the significant risk factors for early childhood mortality. Several studies already have done on this issue by many researchers of Bangladesh [Mohammad & Bari, 2017, Hossain et al., 2011, Karmaker et al., 2014, Chowdhury et al., 2010, Maniruzzaman et al., 2018, Khan & Awan, 2017, Rahman & Sarkar, 2009, Akter et al., 2015, Mondal et al., 2009]. In addition, similar study had done in Sub-Saharan Africa or other developing countries [McGuire, 2006, Ayele et al., 2015, Ezeh et al., 2015, Adedini et al., 2015]. Undoubtedly their findings are very consonant to us that helped to determine the potential risk factors for child mortality.

Our study showed that the risk of U5CM was higher among children from Sylhet division compared with the children in Barisal region. Previous studies in Bangladesh also found that the U5 mortality was higher in Sylhet division [Maniruzzaman et al., 2018, Khan & Awan, 2017]. There is regional gap to access basic medical facilities and this might influence in the observed regional differences in U5 deaths.

The odds ratios of the present study illustrate that fathers having lower educational status, children occupy a great risk of dying during their early childhood. This is a constant result of the previous findings [Akter et al., 2015, Breierova & Duflo, 2004, Mazumder et al., 1997, Uddin & Hossain, 2008, Mondal et al., 2009]. A recent study by Maniruzzaman *et al.,* 2018 revealed that both the parents' education had a significant role on the survival of young children in Bangladesh. But we did not find mothers' education as a significant determinant for U5CM. This might possible because in Bangladesh, most of the families are dominated by men with regard to almost all decision.

This present study revealed vitamin A deficiency as a significant predictor for U5CM. The risk to die had higher in children who did not feed vitamin A capsules during their two months of age. This finding is also consonant with many previous studies in developing countries [Rahmathullah et al., 2003, Klemm et al., 2008, Imdad et al., 2011, Humphrey et al., 1996]. Further, birth status (single vs. multiple) possessed a significant association dying at early childhood period. Children of multiple births were 12.40 times more likely to die before age 5 relative to the reference group of single birth. Previous studies in Bangladesh also identified multiple birth as a significant determinant of U5 mortality [Alam et al., 2007, Hong, 2006]. Besides, similar findings are found from Ethiopia [Bereka et al., 2017] and Zimbabwe [Kembo et al., 2009]. Since a large proportion of multiple birth child die before reaching their 5 years of age, future longitudinal study is required to increase the survival rate among multiple birth children.

The study had faced some limitations, being an analysis of a secondary data set; such important factors were unavailable in the DHS dataset that was considered the prime challenges for this study. Moreover, some variables was excluded (i.e. diarrhea, birth interval) from the study as there was difficulties to fit regression model for this variables. These factors might U5 child mortality [Black et al., 2003, Liu et al., 2010, Maniruzzaman, 2018]. However, these findings may assist for further important policy implications to obliterate the child mortality.

Conclusion

Over the last two decades, the number of deaths among under-5 children has fallen worldwide including Bangladesh. However, yet it remains a significant public health problem in Bangladesh and this paper revealed some important indicator for U5CM after adjusting all possible variables. A nationally representative data had been used to reflect the recent mortality pattern in this country. Different socio-economic, health and demographic factors are associated with U5CM. However, the persistence of U5CM in Bangladesh questions the initiatives of government and other organizations. Hence, the findings uphold adequate measures are ineluctable to extinguish the prevalence of U5CM in Bangladesh. To elevate and augment the child survival the findings of this study could be an adjuvant framework for further designing future health plans and polices towards obtaining workable health initiatives of Bangladesh. Additionally, those variables which were excluded further study is recommend by the authors to include them.

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